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Increasing Line efficiency with COMSOAL, RPW and LCR Methods of Assembly Line Balancing Problem

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ABSTRACT

In this research paper the various heuristic methods namely COMSOAL, Ranked positional weight and Largest candidate rule is described for assembly line balancing problem .In this research paper our aim is to reduce the number of workstations and increasing overall Line Efficiency of simple assembly line balancing problem.

Keywords: COMSOAL, RPW, LCR, SALBP

1.INTRODUCTION

The assembly line was firstly introduced by Henry Ford for producing the T-model car. It has been widely applied for assembling automobiles, appliances, computers and other consumer products. The goal of assembly line designed is to create a smooth, continuous flow along the assembly line with a minimum of idle time at each workstation. Assembly lines are flow line production systems where a series of workstations onwhich interchangeable parts are added to a product are connected sequentially according to the technological restrictions. Assembly line deliver to mass production systems they consists of a number of workstations designed to assemble a specific product or family of products. A product is ready after a complete set of tasks is completed. At each workstation a subset of the tasks is performed. The product is moved from one workstation to next through the line and is complete when it leaves the last workstation. In general that decision problem so called assembly line balancing problem.

Line Balancing means balancing the production line or any assembly line. The main aim of line balancing is to distribute the task evenly over the work station so that the idle time of man of machine can be minimized. Line balancing aims at grouping the facilities or workers in an effective pattern in order to obtain an optimum or most efficient balance of the capacities and flows of the production or assembly processes. Line balancing is levelling the workload across all processes in a cell or value stream to eliminate bottlenecks and excess capacity. A constraint slows the process down and results if waiting for downstream operations and excess volume results in waiting and absorption of fixed cost.

1.1 The objectives of Line Balancing

Line balancing is a main part of a mass production. These kinds of systems, regardless of being different in details, are workstations in a sequence. Row material is included in the line at

the beginning or in the middle. Parts included in the system transfers from one workstation through the other and at the end leaves the system as a completed product. Transfer lines uses manpower very little when compared to assembly lines. The certain properties of Transfer lines are transfer and process of a product automatically through a line. Objectives that should be gained balancing an assembly line are as follows;

1. Regular material flow.
2. Maximum usage of man power and machine capacity.
3. Minimum process times.
4. Minimizing slack times
5. Minimizing workstations.
6. Distribute slack times to workstations.
7. Reduce production costs.

2. Methodology of Line Balancing

2.1 Ranked Positional weight Method

The Ranked Position Weighted Procedure was introduced Helgeson and Birdie. It is superior to above the methods described previously as, it combines the strategies of the Largest Candidates Rule . In this method a RPW (Ranked Positional Weight) is computed for each element. Following steps are followed

Step 1: Draw the precedence diagram

Step 2: For each work element, determine the positional weight. It is the total time on the longest path from the beginning of the operation to the last operation of the network

Step 3: Rank the work elements in descending order of ranked postion weighted (R.P.W). Calculation of RPW would be explained in the example to follow.

Step 4: Assign the work element to a station. Choose the highest RPW element. Then, select the next one. Continue till cycle time is not violated. Follow the precedence constraints also.

Step 5: Repeat step 5 until the precedence are allotted to one station.

2.2 Largest Candidate Rule Method

The steps involved are

Step 1: Draw the network diagram of work element.

Step 2: List all the element in decreasing order of there elemental task time.

Step 3: To assign an element in a work station start from the beginning the list moving downward searching 1st feasible element which can be placed in a work station. a feasible element is one that satisfy precedence requirement and when it is placed in a work station the summation of all the element in the work station must not exceed the cycle time.

Step 4: strike of the element which is assign and continue the process of assigning until all the element are assign.

2.3 COMSOAL Method

The Line Balancing method namely “COMSOAL” is an abbreviation of “Computer Method for Sequencing Operations for Assembly Lines”. Arcus initially developed COMSOAL method in 1966. And it has been mainly applied to solve assembly line balancing problems. The most common purposes of COMSOAL are to minimise idle time, optimize production line efficiency, and minimise the number of workstations. This method can be briefly described according to seven steps

1. The first step is creating the table, which presents all activities lists in order, considering by precedence relationships.

2. Secondly, selecting the available activities from the table that has no predecessor task, in otherwords all predecessor tasks of considering activity need to be finished.

3. Creating the available activities list.

4. Choosing activities from the available lists to the workstation until the total processing time of all activities in the workstation is nearly or equal to the given cycle time.

5. The next step is recreating the new available activity list.

6. Repeating steps 2-5 until all activities are assigned into workstations.

7. The final step is keeping the possible solution and then repeating steps 1-5 to find the alternative solution, until the best solution is obtained.

3. PROBLEM IDENTEFICATION AND DATA COLLECTION

While balancing the assembly line the aim is to either reduce the cycle time or to reduce the Workstation(s) if possible by getting the optimum solution using the latest available techniques. Here our aim is to find out reduce number of work stations. The assembly line balancing problem can be explained as to assign the tasks according to the precedence relations and some other constraints to each workstation for maximum efficiency possible, and thereby achieving the maximum productivity. The objective is to assign the tasks to the workstations such that the idle time should be less and the working of each workstation should be closer to cycle time.

Constraints in line balancing problem

- We should know Precedence relationship for each operation.
- The number of workstations should not be more than total number of tasks i.e. Restriction on number of workstation should be there.
- Station time individually should not be more than cycle time.
- No operation should be greater than the cycle time.
- If any operation found more than cycle time sort it and check it by apply number of workers on it to have within cycle time or separate the operation if possible.

3.1 Formulation of problem

M/s SURIN AUTOMOTIVE Ltd. – It is a vendor for light and heavy vehicle section of M/s Ashok Leyland Company. The Company has large range of products like hcv, lcv, 1616IL, 3116IL, 2516TI and mcv. The company is located in Sitarganj, Rudrapur (Uttarakhand). The company is having multi product mixed model assembly line for producing variety of products at the same time. In multi -product mixed model assembly line balancing, the model having related same operations are grouped together their operations are considered as the chromosomes of same family and accordingly grouped. The cycle time for each work station is 5 min.

The collected data is shown in tabular form.

Task details of Surin Automobiles

Task No.	Task	Activity Description	Task Time (sec)
2	b	longitudinal assy.	180.00
1	a	spot projection welding	120.00
3	c	floor channel station	300.00

4	d	floor panel	300.00
5	e	mig welding	240.00
7	g	bulk head panel	180
6	f	sit mounting	300
8	h	Final assembly	240
11	k	Loose parts	120
12	l	Indicator LH & RH	180
9	i	Headlight assembly	240
13	m	Break paddle	180
10	j	Paint shop	300
14	n	Cluster, wiper motor	240
15	o	Steering	120

To solve this problem heuristic based ranked position weighted method, largest candidate rule and COMSOAL method and compare these three heuristic methods and find out which is more efficient heuristic method.

3.2 Results from Ranked Positional Weight Method

S.no	Description	Existing Setup	RPW
1	Cycle time(sec)	300	300
2	Efficiency(%)	72.00	83.08
3	No of Workstation	15	13
4	No of operations	15	15

3.3 Results from Largest Candidate Rule Method

S.no	Description	Existing Setup	RPW
1	Cycle time(sec)	300	300
2	Efficiency(%)	72.00	77.15
3	No of Workstation	15	14
4	No of operations	15	15

3.4 Results from COMSOAL Method

S.no	Description	Existing Setup	RPW
1	Cycle time(sec)	300	300
2	Efficiency(%)	72.00	90.00
3	No of Workstation	15	12
4	No of operations	15	15

4. Result:- The Comparative analysis of these three methods are as follows

S.no	Desription	Existing setup	RPW	LCR	COMSOAL
1	Cycle time	300	300	300	300
2	Efficiency	72.00	83.08	77.15	90.00

3	No of Workstation	15	13	14	12
4	No of operations	15	15	15	15

5. Conclusion:-The Method COMSOAL is very suitable and gives more stable results for large number tasks. In this research paper we observed that Heuristic approach shown better results as compared with present traditional method. The result showed that all heuristic rule can produce good solutions for the straight line LBP.

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